

## **Google Glass for Education: A Remote Mobile Usability Study of a Responsive Instructional Website**

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**Abstract:** As wearable computing devices, ubiquitous mobile access, and advances in information and communications technology (ICT) become a global reality, the opportunities for innovation in distance learning expand exponentially. Educators face special challenges in designing effective instruction for delivery in online learning environments that are becoming increasingly mobile and many seek professional development resources to acquire the skills and expertise needed to adopt and integrate new technologies into their practices in impactful ways. With the release of the new Google Glass Explorer Edition (Glass), a head-mounted display, came a need to provide instruction for operating Glass with a focus on education. Google Glass in Education, a website of asynchronous, instructional modules (URL: [eLearn.Glass](http://eLearn.Glass)), was created to instruct members of the Google+ Community—Google Glass in Education to impart the fundamentals of operating Google Glass, to record and stream live video, integrate augmented reality, and explore curated resources for educational use. The aim of this mobile usability study was to evaluate the website's ease of use and effectiveness and to improve user satisfaction through iterative usability testing. Overall, data analysis revealed that participants did experience improved ease-of-use and increased satisfaction with the final revised instructional website.

### **Introduction**

Glass is the first consumer edition of a wearable computing device in a head-mounted display (HMD) form factor and along with other HMD devices has the potential to be a highly disruptive piece of technology affording innovative applications in online learning and teaching. Mobile technologies are already pervasive and offer great potential for mobile learning (m-learning) (Gedik, Hanci-Karademirci, Kursun, & Cagiltay, 2012). However, designing instruction for mobile, online delivery presents unique and complex technological challenges. In addition, evaluation of the human-computer experience when using mobile technologies requires special consideration. Accepted methods and guidelines for evaluating traditional, desktop computing do not readily apply to multiple physical environments, non-traditional learning spaces, and the wide range of contexts and purposes typical of mobile learners (Lumsden, 2011).

## **Background and Literature Review**

### **Google Glass Explorer Edition**

The researcher obtained a beta version of Glass while participating in the Google Glass Explorers Program offered to developers from mid-2013 to January 2015. The Google Glass Explorer Edition is a wearable, head-mounted computing device with an optical display in the form of a prism that is situated in the upper right side of one's field of vision where it is easily viewable, but does not impede vision. (See Appendix A.) The prism acts as a miniature projector that reflects an image onto the retina. The size of the image appears to be equivalent to that of a twenty-five-inch television screen viewed at approximately eight feet away. It is operated through voice commands, head motion, or via a touchpad on the right arm of the frame. The built-in camera can take still pictures, as well as record video. When connected to the Internet or another network via Wi-Fi or tethered with Bluetooth, Glass can transmit and share video to remote viewers. It is this feature that has enormous potential in distance learning when it functions as a video conferencing tool that allows individuals or groups of people to share and collaborate over a network. A user can capture static images or broadcast video of what the camera sees from a first-person view.

One of the most compelling features is that Glass is augmented reality (AR)-enabled. The digital layer of information that is viewed via the prism appears on top of the actual real-world scene and is a form of mobile augmented reality (AR). Images are displayed via apps developed for Glass or the user may capture his or her own photos, charts, and graphics and overlay them onto the real-world view they see through Glass, thereby creating a custom AR effect. AR technology creates new opportunities to educate and improve the learning experiences and outcomes for remote learners (Nincarean, Alia, Halim, & Rahman, 2013).

When used in conjunction with Livestream online streaming media services, users can broadcast live from their Glass cameras to the general public worldwide as well as record sessions for later access on video websites, from anywhere at any time. Livestream's mobile live streaming app for Glass includes an interactive feature that enables broadcasters to view real-time chat messages and respond via voice. Research shows that live streaming can improve the synchronous, online learning experience by reducing the sense of isolation and increasing quality interaction and a sense of community (Isaacson, 2013).

### **Mobile Technology and Mobile Learning**

Mobile devices such as smartphones and tablets are more and more prevalent, network speeds continue to increase, and mobile media consumption is growing exponentially. A study by the Pew Research Center's Internet & American Life Project showed that, as of January 2014, 90% of American adults have a cell phone, 58% of American adults have a smartphone, and 42% of American adults own a tablet computer. These have become an

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integral part of our everyday lives (Pew Research (2015)). People use multiple devices in the course of a day and expect to use them seamlessly for a variety of activities, including learning, across multiple contexts and geographic locations.

Mobile technologies afford us new possibilities for teaching and learning. M-learning has all the advantages found in e-learning, which accommodates when, where, and how learners want to study, but also allows for doing so on mobile devices (smartphones and tablets) that are wireless, portable, and handheld (Evans, 2008). This flexibility meets the needs of learners with limited time who need to access instruction anywhere, anytime. It also eliminates the need to carry books and materials as well as facilitates “just-in-time” learning, which allows students to access information the moment they need it (Evans, 2008).

To create effective learning experiences, it is becoming increasingly important to deliver content formatted for the broad array of mobile devices (Jordan, DuClos, Folsom, & Thomas, 2015). Mobile design must accommodate varying screen sizes, operating systems, and browsers as well as numerous physical environments and variable connection speeds. One of the ways we can accommodate these variables is through responsive Web design that allows the appearance of a website to automatically and dynamically change depending on the screen size and its orientation. This enables users to have high quality experiences on all devices, so they can move seamlessly from desktops to tablets to smartphones on the go.

It is important to consider context when designing for mobile devices. We must think about real users and how they will handle their devices in different contexts. People touch and hold their mobile phones differently and change and shift based on what they are doing (Hoover & Berkman, 2011). Designing for mobile means designing for touch.

### **Instructional Media**

Multimedia was selected as the primary method of delivery for the website because the use of video in education increases both the efficiency of learning and the quality of the overall learning experience (Ljubojevic, Vaskovic, Stankovic, & Vaskovic, 2014). It also increases student motivation, which positively affects learning outcomes (Bravo, Amante, Simo, Enache, & Fernandez, 2011). Short videos enhance student satisfaction and motivation to learn online (Hsin & Cigas, 2013). Video attracts viewers’ attention, and as a multi-sensory medium (Marques, 2012), it engages learners on several levels as they go through the learning process, including the verbal (linguistic), visual (spatial), and musical (rhythmic) forms of intelligence. Fostering multiple intelligences yields more effective learning and appeals to learners with disparate learning styles (Gardner, 2007). Animation and video convey more information and increase learner comprehension more than static images (Lin & Atkinson, 2011), especially when pertaining to human motor skills (Arguel & Jamet, 2009). By reducing visual search activity, visual cueing in animation also reduces learning time (Lin & Atkinson, 2011).

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## Usability, User Experience, and User Interface

Usability is a key area of research in m-learning due to its profound effect on its success (Chang, 2006). Problems are prevalent. It can influence a user's perception of an entire learning experience.

Usability is part of a larger discipline of user-centered design, which is the foundation of the overall concept of user experience (UX). A website, or any product or service, can be defined as truly usable “when a user can do what he or she wants to do the way he or she expects to be able to do it, without hindrance, hesitation, or questions” (Rubin & Chisnell, 2008, pg 4). In 2009, Chisnell described the role usability testing plays in optimal user experience: “Every time a person has a great experience with a website, a Web app, a gadget, or a service, it's because a design team made excellent decisions about both design and implementation—decisions based on data about how people use designs. And how can you get that data? Usability testing.”

*Moderated Usability Testing.* One of the most common methods of gathering qualitative data in usability testing is the think-aloud (TA) protocols, which are used to identify problem areas of a website or product in order to improve the user experience (Olmsted-Hawala, Murphy, Hawala, & Ashenfelter, 2010). In this study, the Concurrent Think Aloud (CTA) protocols were used in which users continuously verbalized their thoughts as they interacted with the website while accomplishing a given set of specific tasks (Bergstrom, 2013). This was a moderated protocol, but the moderator severely limited prompts to encourage the subject to continue interaction and communicating his or her thoughts in real-time. This more closely approximates how a user would interact with a website on his or her own without help. At the end of testing, the moderator asked probing and reflective questions that required the subject to think about his or her previous actions (Olmsted, 2010).

*Online Observation & Tracking.* Though the majority of user research should be qualitative (Nielsen, 2012b), a WordPress plugin, Inspectlet, captured quantitative data related to user behavior by capturing screen recordings, reporting details on the device used, and aggregating data in the form of heatmaps. This can reveal usability issues pertaining to proper formatting, display, and functioning on a wide variety of mobile devices. The technology is a tool that can help the researcher to gain a deeper understanding of user interaction in order to make revisions to the prototype and improve usability (Lanier, 2011).

## Project Design

### Population

The target audience in this study was educators from the Google+ Community—Google Glass in Education and others who are representative of this targeted user group. Three females and three males made up the 6 participants for this usability research who are elementary, secondary, and higher education teachers, as well as one undergraduate school counselor. All reside in the state of Hawaii on the islands of Oahu, Maui, and the

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Big Island of Hawaii. They are educators who are highly motivated to explore new ways of integrating new technologies into their practice. All stated that they are comfortable with online learning and have taken more than 5 online courses, though only 2 subjects regularly accessed online courses using a smartphone or tablet. All strongly agree that using smartphones and tablet devices to learn online is useful. MacBook Pros, iPhones, and iPads were the computing devices used for testing in Mozilla Firefox and Google Chrome browsers. The population is technically skilled, spend an average of 2.5–4.25 hours on the Web per day, and use iPhones, laptops, and desktop computers daily. Two subjects use iPads daily. None of the participants had any experience using Google Glass.

### Research Questions

The intent of this study is to answer the following research questions:

RSQ1: How do educators from Google Glass in Education Community, or others who are representative of this targeted user group, perceive the ease-of-use, effectiveness, learnability, and the design, layout, and attractiveness of the instructional website prototype?

RSQ2: As users, how do educators from Google Glass in Education Community, or others who are representative of this targeted user group, rate their overall satisfaction with the website?

RSQ3: Can two rounds of iterative usability testing improve the usability of the instructional website?

### Website Design: eLearn.Glass

To meet the needs of the target population, the researcher designed four web-based m-learning modules that impart the fundamentals of operating Google Glass, recording and streaming video via a Web service, integrating augmented reality, and exploring curated resources for educational purposes. (See Appendix B.) Content was designed and delivered using multimedia and created in line with Mayer's Cognitive Theory of Multimedia Learning and its principles pertaining to reducing the cognitive load on the limited capacity of working memory when using visuals, text, and audio (Clark & Mayer, 2011).

Mobile interaction design is critical to ease-of-use and user satisfaction. The website and architecture of the instructional information combined best practices in Web design and user interface (UI) with instructional design principles. Every aspect of the user experience was determined with explicit intent to increase the cohesiveness of its look, functions, and what it allows a user to do (Garrett, 2010). Usability was the priority in this learner-centered approach from the beginning to end of the development process.

Built in WordPress, the website incorporates a responsive design, which means that it is compatible across devices and the size of their displays. It enables the website to re-flow, reorder, and adapt to different screen layouts for the best viewer experience. The site responds to user actions and scales up or down depending on the size of the user's

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browser window. It is smaller on a smartphone or tablet and larger on a full-size monitor. (See Appendix C.)

The website features a “flat design” theme to ensure simplicity, a de-cluttered appearance, and fast loading speed. Simple images in this type of design make the best use of limited screen space. Limited drop shadows, gradients, and other design elements create a minimalist style that supports readability on mobile devices.



**Figure 1.** Responsive design of Google Glass in Education website.

### Instructional Content

Instructional design followed the ADDIE model for the four modules chunked in a linear sequence.

The researcher searched the Web, but could not find a comprehensive visual summary of Glass’ features. Adobe After Effects and a 3D model of Glass were used to create a short animated video identifying the features and functions of the components for display on the homepage. (See Appendix D.)

Other short (1-3 minute), high quality videos were found on the Web that explained various procedures. These learning objects were scaffolded and chunked in a linear sequence. Learners were urged to get hands-on practice with Glass in between each video, and users who have Glass and were already familiar with the very basic functions were directed to skip the first modules. Screencasts demonstrate the installation and operation of Livestream’s mobile live streaming app for Glass.

## Methods

### Recruitment

Volunteer subjects for the usability tests were recruited via email and telephone. The sample included subjects from Facebook and the Google Glass in Education Community, local college faculty and staff, secondary education teachers, graduate students in the Educational Technology field, and other subject matter experts. An email and flyer (Appendix E) explained the usability research. Volunteers were directed to contact the researcher for more information and to schedule tests. The plan was to test a minimum of 6 participants in two rounds of testing conducted online and in-person. Typically, testing 5 users will identify major usability issues and testing more users has diminishing returns (Nielsen, 2012a).

### Data Collection and Analysis

Qualitative and quantitative methods were employed in the collection of data in this usability research. Data were gathered by administering two successive rounds of moderated usability tests over a 5-week period. Subjects interfaced with the researcher remotely online to evaluate the ease of use and the effectiveness of the instructional website. Volunteers had the option of participating in usability tests in one of two ways as preferred by the participant: 1) moderated testing completely online through a Google Hangout with the researcher while using his or her own mobile device or computer and Internet connection, or 2) moderated in-person at a mutually agreed upon location using his or her own mobile device or computer or one provided by the researcher. All chose the remote online usability test option.

All volunteer participants were required to review a letter of consent and accept the terms before proceeding in the study. Participants were asked to navigate naturally and freely through the instructional website while the researcher guided them through a series of representative scenario tasks. They were asked to follow concurrent, think-aloud protocols by verbalizing their thoughts out loud as they navigated the website to complete the tasks. Screen activity and audio were recorded, but no recognizable images of the participant themselves were captured.

Pre- and post-test surveys (Appendix F) were administered to collect data pertaining to demographics, attitudes, behavior, experience, and past technology use prior to the session, and website design, user satisfaction, and the users' experience in using and navigating the site following the session. Both surveys were developed with the Pinnion plugin for WordPress, because it lends itself to formatting for mobile devices better than the alternatives. Questionnaires were designed to collect quantitative data through multiple-choice responses using a 5-point Likert scale. Open-ended survey questions with space for free form, narrative comments provided qualitative data. (See Appendix G.) A debriefing interview followed the moderated usability tests. The time commitment was approximately 5 minutes for the pre-test survey, 15-20 minutes for the usability test, and 10-15 minutes for the post-test survey and short debriefing interview.

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Activity on the screen was also recorded with the specialized research tool Inspectlet, a WordPress plugin that allows the researcher to observe, capture, and analyze user behavior on the instructional website. It is an observation tool that allows one to see exactly what website visitors were doing on each webpage, including what they saw, where they clicked, and with what elements they interacted. It aggregates quantitative data into mouse click or touch tracking recordings and page scrolling heatmaps as visual representations of activity. Additionally, Inspectlet captures a screen recording of what each individual user does on each webpage in each individual session. Recorded sessions were archived on the Inspectlet website for later review and analysis during the study. Metrics identified were the type and version of the user's browser, computer platform, screen size, time, date, and number of page visits.

### **Remote Mobile Usability Testing Technologies**

The approach to usability testing on mobile devices differs significantly from testing on desktop and laptop computers. The logistics for mobile devices are more complicated. Remote testing in this study necessitated a means of mirroring the screen of the participants' mobile device to his or her laptop or desktop computer screen, which could then be shared with the researcher over the Web. The AirPlay feature of iPhones and iPads made linking easier, but technology is limited for other mobile devices. This procedure also required a participant to download and install software in order for his or her computer to function as a receiver for the connection to AirPlay. (See Appendix H.)

Recruiting participants for remote usability testing is difficult because of the time and extra steps and required to obtain and install the necessary software. Pre-screening is required to identify subjects who have recent versions of Apple devices and operating systems. Representative participants must be regular iPhone or iPad users and willing to commit the extra time and effort to prepare for testing. Only current versions of those devices and iOS software have the built-in AirPlay feature that allows wireless streaming of content for mirroring.

### **Analysis and Reporting**

Following each of the two rounds of usability testing, all qualitative and quantitative data were aggregated and analyzed to identify primary difficulties and the most significant issues by looking at frequency of occurrence, impact on user experience, and persistence of the problem. Revisions to the website prototype, selected based on feasibility, were made to address identified areas of improvement. The result was two iterations of the website. (See Appendix I.) Progress was tracked between iterations.

## **Results**

### **Qualitative Results**

Testing revealed a number of usability issues. (See Appendix J for an itemized list of



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findings and corresponding revisions.) The first iteration of the website prototype was designed as a self-contained website that included the usability test and incorporated all the necessary elements to complete the usability research. Originally, subjects had the option to participate in either a moderated or un-moderated test. Structured as a linear process, the user reviewed and accepted the terms of the letter of consent, took the pre-survey, continued on through the instructional modules, and finished with the post-test survey. It was very evident that the first two subjects found this to be extremely confusing and frustrating. In terms of learnability, they had difficulty understanding how to proceed. The architecture and content was revised by removing most components strictly related to usability testing and eliminating the un-moderated test option. (See Appendix I.) The pre-test portions and surveys were completed outside of the instructional website in the second iteration.

Designing for mobile is designing for touch screens. Observation and user comments identified problems with navigation buttons at the bottom of the webpages and the navigation bar at the top, which was considered incomplete without a dropdown menu for direct navigation to individual instructional modules. Content contained in drop-down panels to conserve space was designed to display when an arrow on the right end of the bar was touched to open the panel. The recordings generated in Inspectlet (Appendix K) that indicate where testers clicked, along with participant comments and observation, revealed that users touched the bar graphic several times in the middle and on other points of the bar when attempting to open the panel. The small touch target was not clearly recognizable or easy to use.

Revisions to mitigate these issues and improve ease-of-use focused on the visibility, placement, and size of all touch targets in the second iteration of the website. The researcher used a digital touch overlay scaled to 100% size as a guide (Hoover & Berkman, 2011). (See Appendix L.) Placing the overlay over the smartphone-sized screen indicated the preferred touch zone and accuracy dots showed the spacing required to ensure no other touch target was too close to cause the user to accidentally click it. The webpage layout was revised so that videos and drop-down panels, as the primary touch targets, were placed in the middle of the screen and the secondary navigation targets were correctly sized at the top and bottom. The bars at the top of the drop-down panels were recoded to make the entire bar a touch target, thereby eliminating the need to access panels via the small arrow on the right. The bottom navigation buttons were enlarged to accommodate larger finger sizes and broken links were corrected. A drop-down menu was added to the top navigation bar to facilitate direct access to the instructional modules.

Though all participants accessed the Web via Wi-Fi, download speeds are variable and often slow on mobile devices. Videos were featured prominently as learning objects on the website and user feedback indicated that some pages would be more user-friendly if they downloaded faster. To improve page load speeds, a WordPress plugin WP Super Cache was installed. It added a caching engine that stores website data so repeated requests for it on other webpages do not require downloading again. Data retrieved from the cache means fewer requests to the Web server and results in quicker response times.

## Quantitative Results

At the end of the usability test, each subject completed an online post-test survey rating their perceptions of the instructional modules and website overall. The researcher calculated four composite scores that were the average of the responses for each usability factor. Table 1 includes the mean ratings for each of the four usability factors presented separately for the first and second iterations of the website and indicates the percentage of change.

**Table 1.** Mean participant ratings of usability factors.

Usability factor	Mean* 1st Iteration n=3	Mean* 2nd Iteration n=3	Change (%)
User satisfaction	4.67	5.00	+7
Ease-of-use	4.72	4.83	+2.3
Design, layout, & attractiveness	4.62	4.95	+7.1
Learnability	4.67	5.00	+7

\*Based on a 5-point Likert scale: 1 = Strongly disagree, 5 = Strongly agree.

The quantitative findings in round two show that all usability categories showed overall improvement. Gains were modest, but ratings from the first round were already high. User satisfaction, design, and learnability realized the largest gains with a 7% increase.

Data provided by the WordPress plugin Inspectlet included video capture of all sessions, clickmaps, and information pertaining to each users' device, operating system, browser, and timing. These plugin features were the most useful for observation and analysis. Videos showed where users clicked and scrolled, which made it easy to identify major problems. Inspectlet also generated heatmaps that displayed clicks and touch interactions and scrolling patterns representative of user behavior. While this might be valuable for determining user behavior on large websites with a large amount of traffic, the plugin was not as useful for evaluating usability in a session with one individual. Because isolating a single user test requires activating the plugin at the beginning of the evaluation and deactivating it at the end, data were insufficient for generating actionable heatmaps.

## Discussion

Conducting remote mobile usability testing was far more complicated and time consuming than initially planned. The technologies necessary to implement this mobile study required additional effort for both researcher and participants. Requiring subjects

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to install new software and operate in new online environments takes additional time and makes recruiting volunteers more difficult.

Iterative mobile usability testing fully integrated throughout the development of this instructional website improved usability. Educators' ratings of ease-of-use and overall satisfaction increased when usability issues were identified and revised based on those findings. Two rounds of testing were conducted in this research and identified major issues. Revisions were made and a second iteration of the website was tested. Repeating the process a third time could have further refined the effectiveness and attractiveness of the instructional website, but high ratings achieved in the second round suggest that improvements would be small in an additional iteration. However, usability testing should continue in the future as new content is added to the website.

### **Limitations**

A small sample of the population participated in the research study, which may have affected the findings. Though it is common to enlist as few as five participants to identify most major problems, evaluating mobile usability requires a larger sample in order to evaluate usability in the multitude of conditions and contexts inherent in mobile computing. Additionally, the accuracy of mobile usability test results may increase as the number and variety of different devices increases. AirPlay, a feature of iOS devices, enabled users to mirror their mobile screens to a laptop, which was then shared remotely with the moderator via Google Hangouts' screen sharing capability. Including a variety of devices with other operating systems would provide a more thorough evaluation. Testing in different environmental contexts authentic to mobile device use may also strengthen test results. Future work to develop best practices for mobile testing approaches in both lab environments and authentic real-world environments in the field would significantly contribute to the existing body of research on this topic.

### **Directions for Future Research**

Remote usability testing yielded actionable data, but one-on-one testing with a participant in a lab is a consideration for future research. A formal lab-based set-up with a camera able to record a tester in the process of using his or her device would reveal how users actually hold, interact with, and touch such devices. (See Appendix M.) Observing the recording would provide a more complete picture and uncover usability issues. An additional camera to record the subject's eyes and facial expressions would yield even more data. Sending these video feeds to a separate room would provide stakeholders the option of observing the test in real-time and offer the researcher a means of obtaining their impressions. Time limitations in this study made creating such a lab unfeasible.

Adding functionality to the website could improve users' experiences. A large number of short videos are presented as learning objects, which are large files. Download speeds are critical for user satisfaction. Incorporating code that "lazy loads" videos may improve page load times. Instead of downloading all media on a webpage at once, videos download once they appear on the screen only when needed.

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Conducting an eye-tracking test to track a user's eye movement would be a sophisticated research technique in future testing. Results would show where a user's visual attention goes and what elements attract the most and least attention. Data could be aggregated into heatmaps that combine the results for the entire population sample. This approach can obtain unbiased data that differ from verbalizing what users' perceive. The cost of equipment and complexity involved warrants a cost-benefit analysis to determine the feasibility of conducting such a test.

### **Conclusion**

It's not just the technology that is significant. It is what it allows us to do. Google Glass and augmented reality are new technologies that can impact the way education is conceived and delivered. By leveraging it with the information and communication technologies possible on the Internet, we have the opportunity to create innovative and effective learning at a distance on mobile devices that are widely used in everyday activities. Learning can be seamless across devices, activities, and locations anytime. The virtually distributed learning environment has never before been so conducive to experiences in which learners engage and interact with others in authentic, real-world contexts and co-construct knowledge for deep, meaningful learning.

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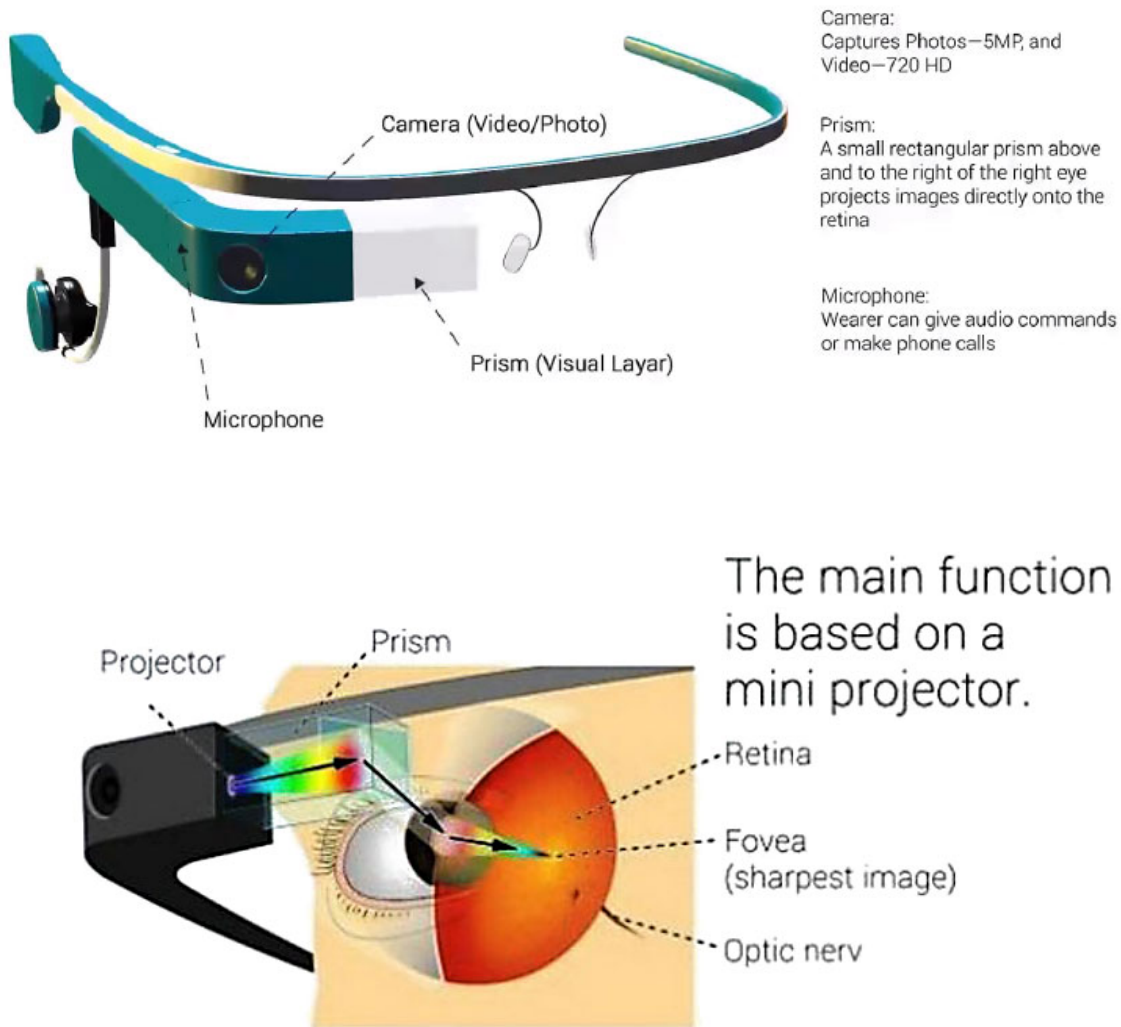
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## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

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## Appendix A Google Glass

### Google Glass Explorer Edition



Above graphic was adapted from "Google Glass Infographic" by Martin Missfeldt is licensed under Creative Commons CC-BY. <http://www.brillen-sehhilfen.de/en/googleglass/> <http://creativecommons.org/licenses/by/3.0/>



## Appendix B Instructional Modules

### m-learning modules

web-based instructional modules optimized for mobile devices providing instruction in the fundamentals of operating Google Glass, a head-mounted display, to record & stream video, integrate augmented reality, and explore curated resources for educational use.

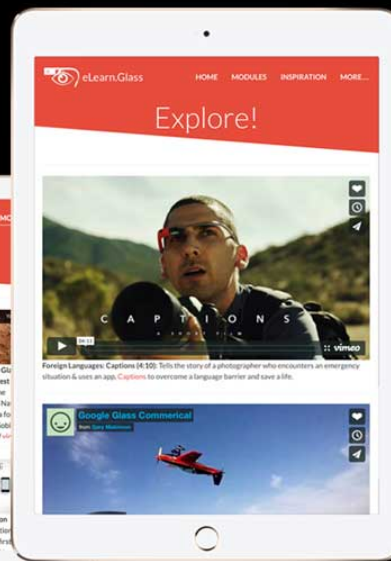
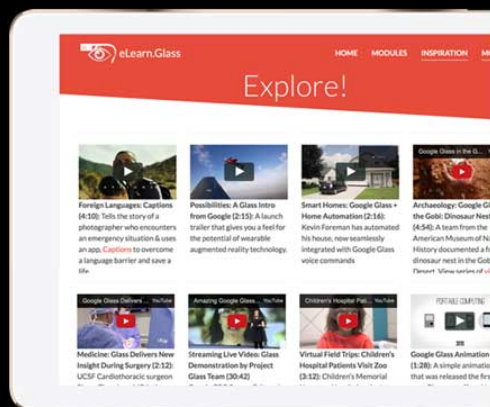


## Appendix C Responsive Website Design

responsive  
website  
design

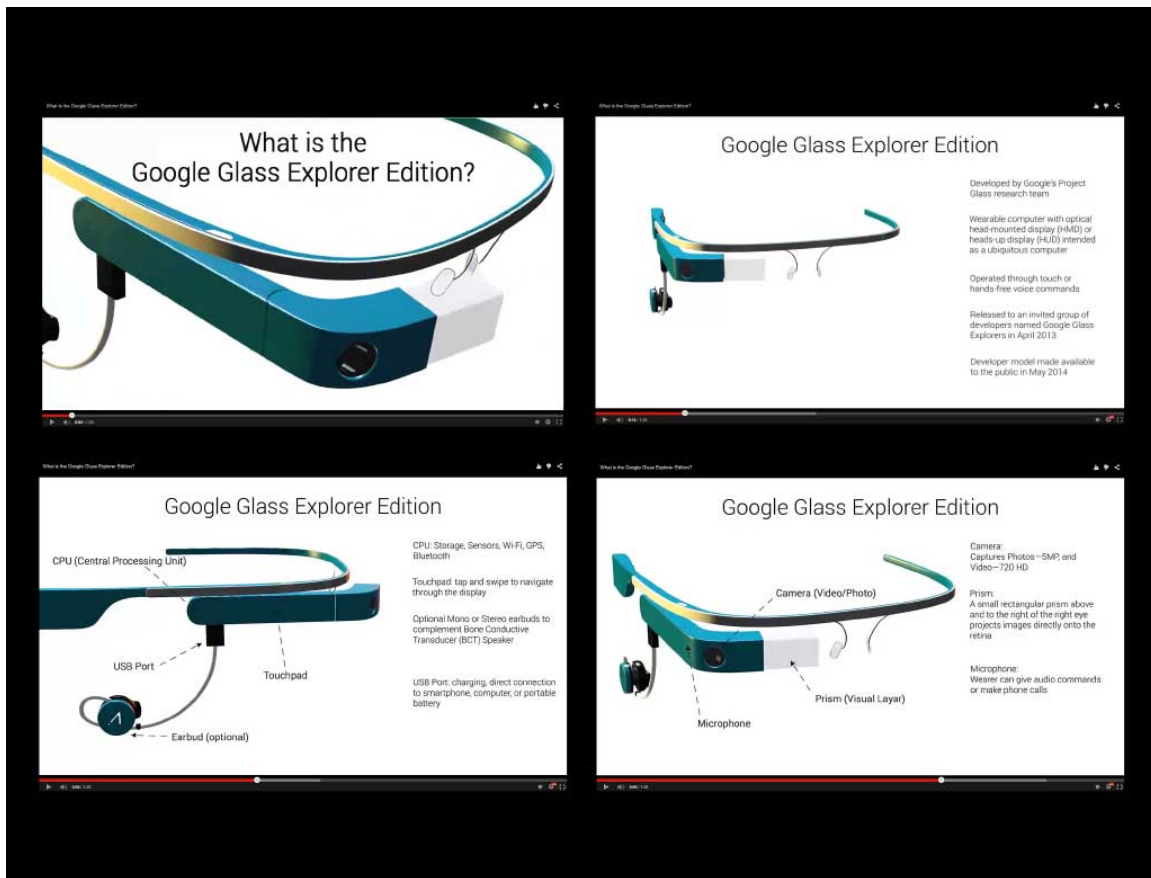


optimized for mobile delivery, compatible across devices, responds to user actions, and automatically and dynamically reorganizes its layout for the best user experience.



# MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

## Appendix D Animated 3D Video



# MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

## **Appendix E Recruitment Email and Flyer**

To: Email Recipients  
From: Patty Stemmler, [stemmler@hawaii.edu](mailto:stemmler@hawaii.edu)  
Subject: Call for Research Participants

Help Evaluate a Website & Learn About Google Glass!

Hi! My name is Patty Stemmler and I am a Master's student at the University of Hawaii College of Education, Learning Design and Technology Department.

As a requirement to graduate, my final project is to create a Web site of instructional modules and have volunteers test its usability and ease of use in order to improve it. Google Glass is not needed to test the website, but volunteers on Maui can try Google Glass!


The purpose of this usability research is to evaluate and improve user satisfaction and the effectiveness of a Web site that features instructional modules for mobile devices that are designed to teach educators how to utilize Google Glass, a head-mounted display, to record and stream video and capture images for educational use.

**Participants will spend approximately 15-20 minutes testing the website and around 5 minutes to complete a short survey before the test and an 8-10 minute survey afterwards in January/February 2015.**

- This can be done in-person at the UH Maui College campus or a mutually agreed upon location, or completely online from anywhere. Those who meet in-person on Maui will have the opportunity to experience some simple apps on Google Glass.
- All results of the study will be kept confidential and no personally identifiable information will be kept.

Please see the flyer below.

To learn more about joining the study, please email Patty Stemmler at [\*\*stemmler@hawaii.edu\*\*](mailto:stemmler@hawaii.edu)



GLASS

# University of Hawaii Website Usability Research

Wearable Computing in  
Distance Learning:

Record and Stream  
Live Video Using  
Google Glass

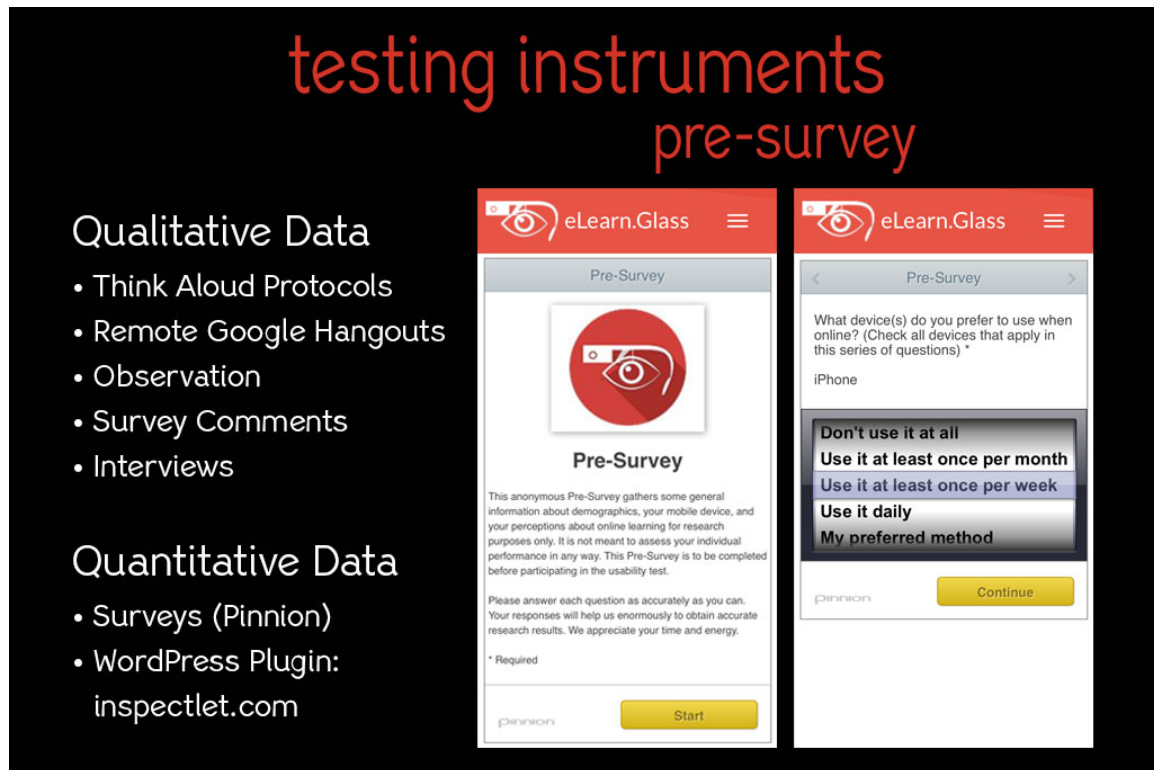
**Google Glass  
Not Needed  
to Evaluate  
Website**

**Evaluate a website & learn more about Google Glass**

To learn more about the study, please email: Patty Stemmler at [stemmler@hawaii.edu](mailto:stemmler@hawaii.edu)

## Appendix F Surveys

### Pre-Survey



### Pre-Study Survey

This pre-survey is designed to gather background information regarding demographics, attitudes, and technology use for the research purposes only, and is not meant to assess your individual performance. This pre-survey is to be completed before participating in the usability test. \* Required

What is your gender? \*

- ☐ Male
- ☐ Female

What is your age group? \*

- ☐ 18-24
- ☐ 25-34
- ☐ 35-44
- ☐ 45-54

## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

- ☐ 55-64
- ☐ 65+

How comfortable are you with online learning? \*

- ☐ Comfortable
- ☐ Somewhat comfortable
- ☐ Somewhat uncomfortable
- ☐ Uncomfortable

How many online courses have you taken? \*

- ☐ 0
- ☐ 1-3
- ☐ 4-6
- ☐ >7

Have you regularly accessed an online course using a smartphone or tablet? \*

- ☐ Yes
- ☐ No

How many online courses have you taught? \*

- ☐ 0
- ☐ 1-3
- ☐ 4-6
- ☐ >7

How many online courses have you developed? \*

- ☐ 0
- ☐ 1-3
- ☐ 4-6
- ☐ >7

How many websites have you authored, built, or developed? \*

- ☐ 0
- ☐ 1-3
- ☐ 4-6
- ☐ >7

What kind of device will you be using for this usability study? \*

- ☐ Tablet

## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

Brand/Model:

- ☐ Smartphone

Brand/Model:

- ☐ Netbook

Brand/Model:

- ☐ Laptop Computer

Brand/Model:

- ☐ Desktop Computer

Brand/Model:

How is your device connected to the Internet for this usability study? \*

- ☐ Wi-Fi  
☐ Cellular  
☐ High Speed Cable  
☐ DSL  
☐ Dial-Up Service

What browser are you using for this usability study? \*

- ☐ Mozilla Firefox  
☐ Google Chrome  
☐ Safari  
☐ Opera  
☐ Internet Explorer  
☐ Other

Please indicate your browser's version number:



## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

What device(s) do you prefer to use when online? (Check all devices that apply) \*

Device	Don't use it at all	Use it at least once per month	Use it at least once per week	Use it daily	My preferred method
Desktop computer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Laptop computer	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Netbook	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
iPad tablet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Android tablet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Windows tablet	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
iPhone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Android phone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Windows phone	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Google Glass	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Comments/Details:					

Generally speaking, how comfortable do you feel navigating websites on mobile devices such as smartphones or tablets? \*

- ☐ Comfortable
- ☐ Somewhat comfortable
- ☐ Somewhat uncomfortable
- ☐ Uncomfortable

How much time do you spend on the Web every day (including work, browsing the Web, email, social media, games)? \*

- ☐ Less than one hour
- ☐ 1-2 hours
- ☐ 3-5 hours
- ☐ 6-8 hours

## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

- ☐ More than 8 hours

I think using smartphones and tablet devices to learn online is useful. \*

- ☐ Strongly agree
- ☐ Agree
- ☐ Neutral
- ☐ Disagree
- ☐ Strongly disagree

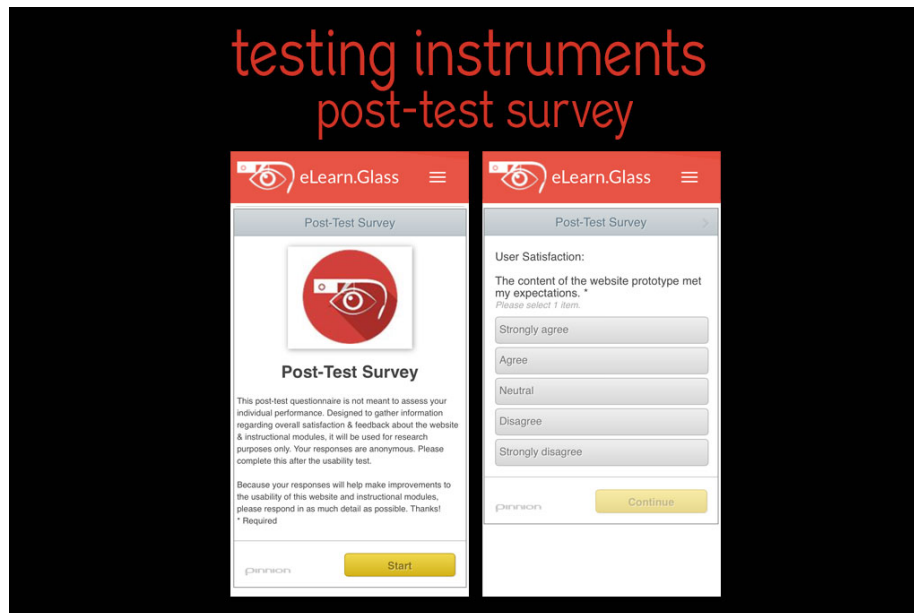
Comments:

Do you have any experience using Google Glass? \*

- ☐ Yes
- ☐ No

Please describe:

### Post-Test Survey



## Post-Test Survey

This post-test questionnaire is not meant to assess your individual performance. It is designed to gather information regarding overall satisfaction and feedback about the website and instructional modules. This information is to be used for the research purposes only. Your responses are anonymous. This post questionnaire is to be completed after the usability test.

**Because your responses will help make improvements to the usability of this website and instructional modules, please respond in as much detail as possible. Thanks!**

\*Required

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
<b>User Satisfaction</b>					
The content of the website prototype met my expectations. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I felt very confident using the website prototype. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The response time and information display was fast enough. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Ease of Use</b>					
Overall, the website prototype is easy to use. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This website and instructional modules are easy to navigate. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
This website and instructional modules are easy to read. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Organization of the information is very clear. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The sequence of pages was very clear. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I was able to complete my tasks in a reasonable amount of time. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Design, Layout, &amp; Attractiveness</b>					
This website prototype was visually appealing. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The interface of this website prototype is pleasant. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The various functions in this website prototype are well integrated. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Individual pages are well designed. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Color was appropriately used in this website. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

The pictures and media on the screen are of satisfactory quality and size. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The amount of information displayed on the screen was adequate. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Learnability</b>					
This website and instructional modules are easy to understand. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I would imagine that most people would learn to use this website very quickly. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Technology &amp; Device</b>					
It was easy to view the website prototype on a mobile device. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think using mobile devices to learn online is useful. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
<b>Usability Study</b>					
The tasks for the usability study were clear to me. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Overall, I was comfortable participating in the usability test. *	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

What did you like the most about the website and instructional modules?

Comments:

What suggestions for improvement do you have?

Comments:

Do you have anything else you wish to share?

Comments:

**Thank you for contributing to this project and supporting research at  
the College of Education, University of Hawai‘i at Mānoa.**

**Appendix G**  
**Selection of User Comments**

**What did you like the most about the website and instructional modules?**

- There was a lot of information that allowed me to see the many possibilities of Google Glass and also I liked the layout and design.
- I liked the amount of resources that were available on this subject and the variety of how Glass is used.
- I liked that they integrated video into the learning.
- The orange color and the simple design of the website.
- I liked the colors (red) and the overall symmetry and composition of the site's layout.

**What suggestions for improvement do you have?**

- Open up links to a separate window. Make sure links work. Fix Module 3 bottom navigation button.
- Use less video clips.
- The main issue was just that I was not able to scroll down to take the surveys.
- The further exploration page had a lot of unsorted / uncategorized links. I would like to see them sorted.
- None

**Do you have anything else you wish to share?**

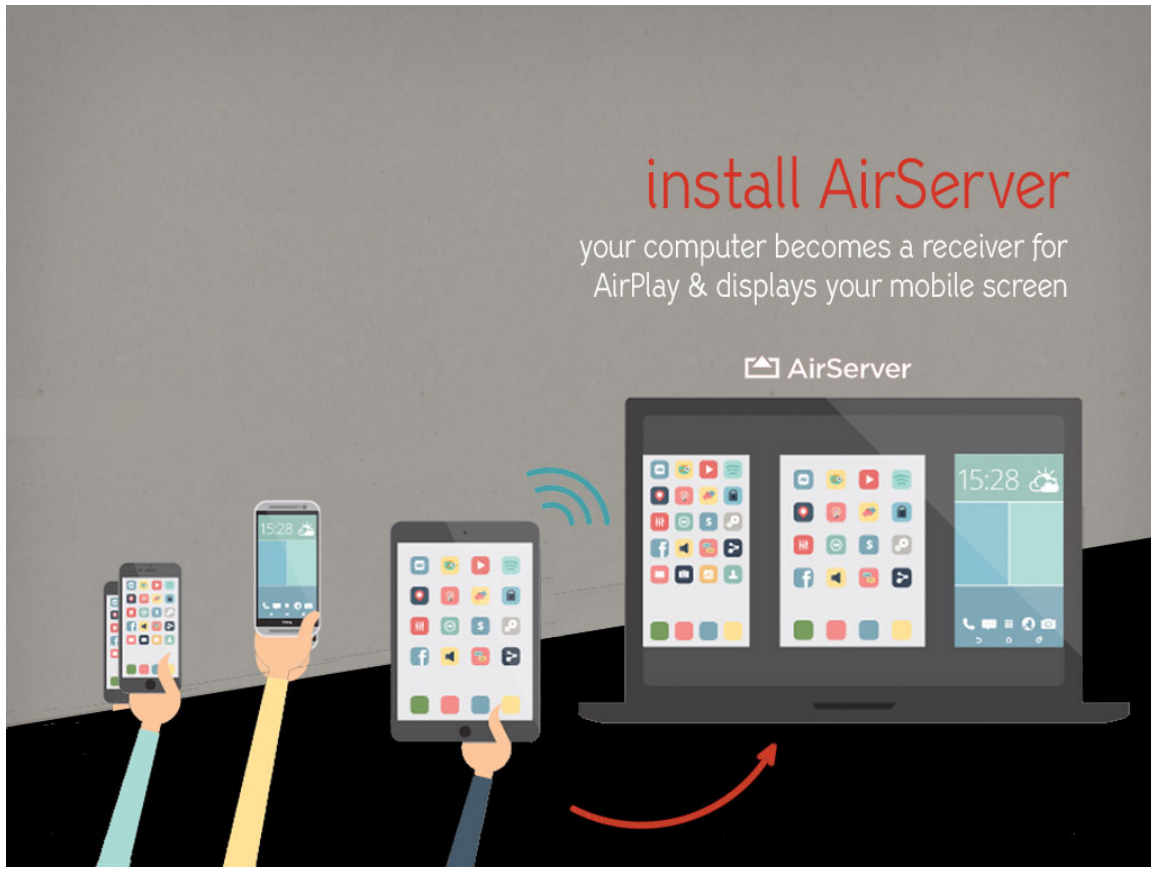
- I'd like to go back to view some of the video.
- A lot of information and a great site to learn about how to use Glass and where to apply them.
- It's a great site! I love that a lot of information is provided and that there are many videos. I like to watch videos when learning new things! I really liked the inspiration videos - who knew the tons of possibilities to use Glass.
- I enjoyed learning about Google Glass being used in ways that "do" something like in medicine and education. I am used to seeing GG used as voyeuristic device to make people feel generally uncomfortable.
- It was a great experience.

# MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

## Appendix H Remote Usability Testing Technologies



## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE



## Appendix I Before and After Screenshots

### before & after

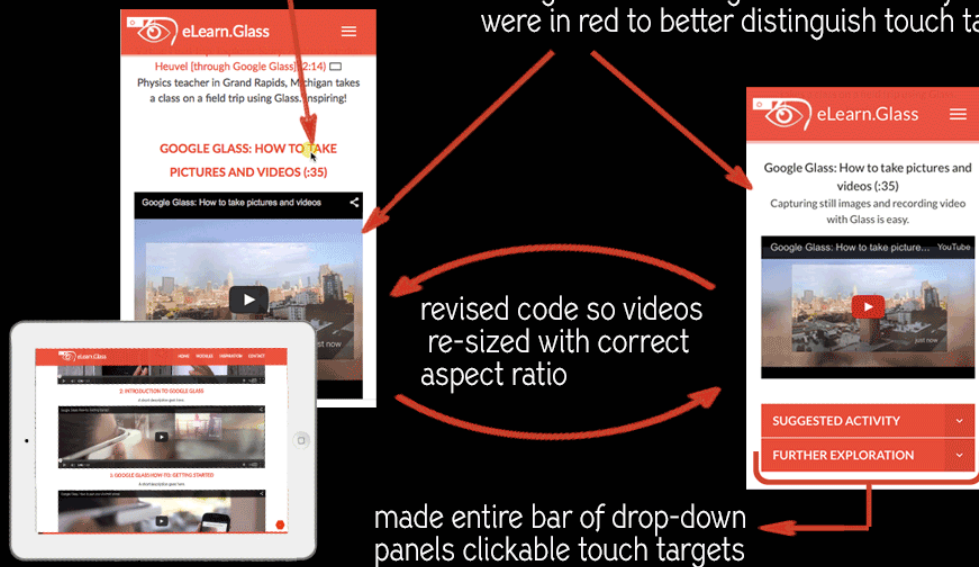
- eliminated study components from site
- streamlined & enlarged bottom nav buttons



Inspectlet video capture screenshot: yellow dot indicates user's attempt to click on title, which was not a touch target

### before & after

changed red headings to black so only links were in red to better distinguish touch target





## **Appendix J Top Usability Issues**

Finding 1: Inclusion of the usability test components within the website architecture was confusing and frustrating. Participants had difficulty understanding how to proceed making the learnability factor very low.

1. Eliminated usability study elements of website to streamline navigation and increase learnability. Usability related activities, including the Letter of Consent, Pre-Survey, and Post-Test Survey were administered before and after users' evaluation activities on the website. Website was easier to use when presented as instructional site alone in second round of testing.

Finding 2: Download speeds were slow.

2. To improve page load speeds, the WordPress plugin WP Super Cache was installed to store data repeatedly requested from the web server.

Finding 3: Organization of content among the modules was not chunked in manageable sizes, not scaffolded correctly, or not accurately placed.

3. Combined the Record Video and Stream Live Video modules and added an additional module dedicated to Education in order to consolidate the abundance of related resources and present them in a logical progression for learning.
4. Integrated Inspiration videos section of the website into the instructional flow by making it more noticeable and linked the Next button at the bottom of the fourth module to the Inspiration webpage.

Finding 4: Visibility, placement, and size of touch targets and primary information were obstacles to efficient use of the website. (See Appendix L.)

5. Navigation and learnability: enlarged navigation buttons at the bottom of all pages to be more noticeable, more accurately sized for touch navigation, and to better indicate the steps to follow in the instructional process.
6. Navigation: changed the breakpoint of the top navbar so that all the text for individual links were visible across the top of the browser window when viewed on an iPad in portrait view instead of showing an icon that hid the menu.
7. Navigation: added dropdown menu in the top navbar under the Modules link to identify individual modules for direct navigation to each.
8. Design: made the entire bars of the dropdown panels touch targets instead of opening dropdown panels only when the arrow or text at each end of each bar was

## MOBILE USABILITY STUDY OF AN EDUCATIONAL WEBSITE

clicked or touched. Tests revealed that users tried to click on other parts of the bar.

Finding 5: The responsive website design was not maintaining the correct aspect ratio for videos when browser window was resized. (See Appendix G.)

9. Revised code to ensure that video players were fluid and maintained the correct aspect ratio when viewed in a range of widths in browsers on smartphones, tablets, and laptops.

Finding 6: Headings and links were not clearly identified and some links were broken.

10. Revised color scheme to delineate links from headlines and subheads. Instead of using red for all, headlines and subheads were changed to 90% black.
11. Inserted small inline icons to visually represent external links, PDFs, and videos, which indicated that the user would navigate to a different website when clicking on the link.
12. Added the total minutes to each video title to indicate its length.
13. Checked all links to ensure they work correctly.

Finding 7: Some design elements took up more space than was necessary, especially when viewed on smaller mobile devices.

14. Decreased the leading in the subheads in the slider sections to reduce the amount of vertical space used and to enable users to access content at a higher point on the webpage.
15. Added drop-down panels to group resources to limit the length of pages.

## Appendix K Inspectlet Video Capture Screenshot

The screenshot displays the Inspectlet interface for video capture and heatmaps. At the top left, the text "inspectlet—plugin" is shown in orange, with "screen capture", "heatmaps", and "inspectlet.com" listed to its right. A blue box on the top right contains the "inspectlet" logo. The central part of the image shows a laptop screen displaying a web browser with the URL "http://localhost:8080/". Red arrows point to various elements on the browser page: "User I.D.", "Platform", "Screen Size", "Date & Time", and "Browser". Below the laptop screen, a "click heatmap" is visible, showing a red area on the "Google Glass for Education" page. To the right of the laptop, a red box contains the text "Clicks = 8" and "Trying to open drop-down panel". On the far right, a mobile device screen displays the "eLearn.Glass" app interface, which includes a "SUGGESTED ACTIVITY" section with text about building a first-person video lesson, a "FURTHER EXPLORATION" section, and a "STREAM VIDEO WITH LIVESTREAM" button.

inspectlet—plugin

screen capture  
heatmaps  
inspectlet.com

inspectlet

User I.D.  
Platform  
Screen Size  
Date & Time  
Browser

click heatmap

Clicks = 8  
Trying to open drop-down panel

eLearn.Glass

Capturing still images and recording video with Glass is easy.

SUGGESTED ACTIVITY

Build your own first-person video lesson. Familiarize yourself with filming with Glass. Create a video for a flipped classroom. Take your students on a virtual field trip. Recommendations: Keep it simple and brief. Avoid capturing unnecessary footage. Recording long videos burns up the battery, so use a rechargeable USB pack to extend filming time if possible. Have fun!

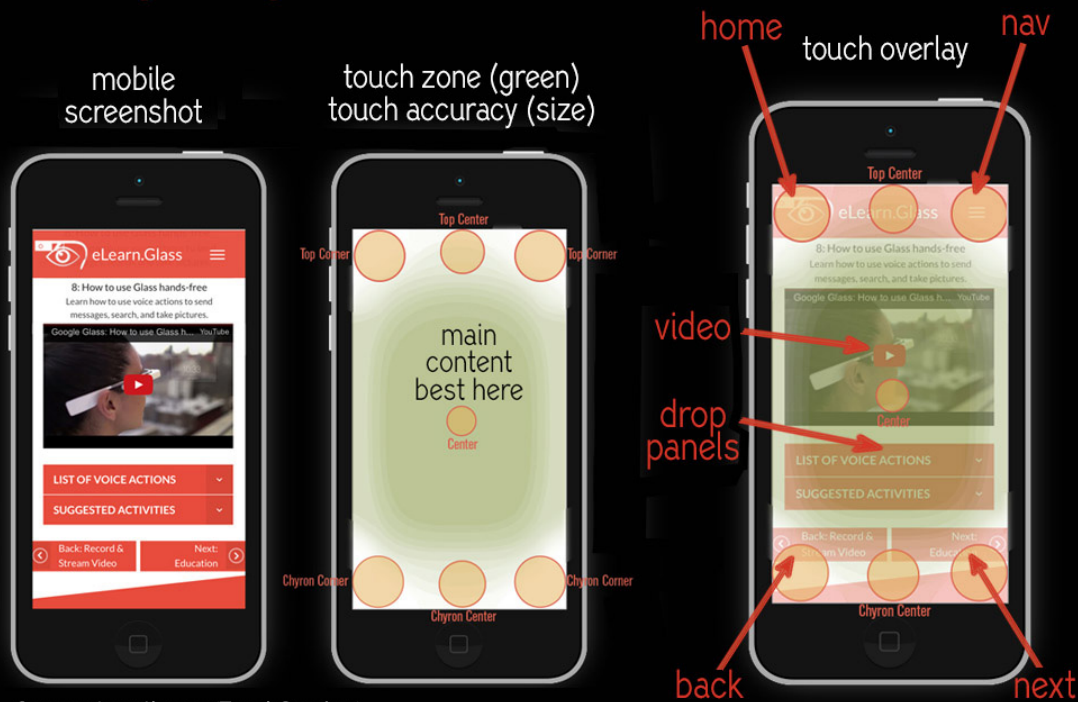
FURTHER EXPLORATION

STREAM VIDEO WITH LIVESTREAM

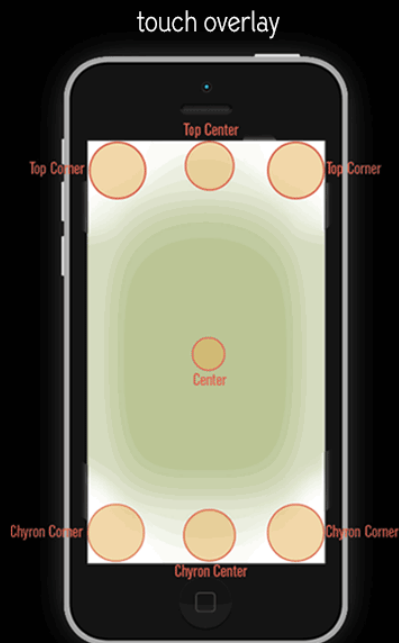
## Appendix L

### Touch Overlay for Touch Accuracy and Target Size

# designing for touch



Source: 4ourth.com/TouchOverlay/



download at source: 4ourth.com/TouchOverlay/

# designing for touch

## the accuracy zone—green area:

- area where people touch their mobile device screens most accurately
- where people are confident at tapping & where they wish to view content
- place key content & primary controls in the center, then check spacing with the accuracy dots

## the accuracy dots:

- set of representative touch sizes
- to test any touch target, position overlay over the target
- users will make accidental taps if any other touch target is within that circle
- use the size of the circles to make a grid to guide your spacing

## Appendix M Usability Testing Lab with Video

